Space Weather Technical Forecast

Issued on Wednesday, 26 April 2023 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: G1/Minor-G2/Moderate Storm risk Days 1-3 (26-28 Apr). Slight chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout. Chance of Active fluence Days 1 and 4 (26 and 29 Apr).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only a small number of minor C-class flares observed. There are currently six sunspot regions on the visible disc. AR3285 and AR3288 in the southeast quadrant are the currently two largest regions on the disc, although both are relatively simple, if close together. AR3289 near the northeastern limb may prove to be a larger region, but is too near the limb for a complete view or a proper classification. AR3290 has emerged recently and may continue to develop further in the coming hours. All other remaining sunspot regions are small and simple at present.
A filament eruption from the southwest quadrant beginning around 25/1900 UTC has led to a CME which is mostly directed south and west of Earth. There is a very low chance of a glancing blow during 28 April. A further filament eruption around 26/0545 UTC, also from the southwest, appears directed slightly further away from Earth although assessment is ongoing.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has shown elevated wind speeds perhaps due to some minor High Speed Stream (HSS) influence. Wind speeds have varied between 490-550 km/s. The density has been fairly steady at average or just above average levels. The IMF (Bt) was weak at 6 nT or below. The north-south component (Bz) has been mostly weakly southward directed, between +/-5 nT. The phi angle switched from positive (away from the Sun) to negative (towards the Sun) at 25/1810 UTC. Geomagnetic activity has been Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at background levels throughout. High energy electron flux (greater than 2MeV) as measured at GOES16, has been at background to moderate levels. The associated 24-hour electron fluence was below the Active threshold on a steady trend, with 1.29e7 integrated pfu observed at 26/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to remain Low, with a slight chance of reaching Moderate levels.

Solar Wind / Geomagnetic Activity: A filament eruption on 24 April produced a CME which may give a glancing blow at Earth in the first half of Day 2 (27 Apr). A further filament eruption on 25 April gave another CME which is considered most likely to miss, but there is a very low risk of a glancing blow during 28 April.
Solar wind speeds remain at elevated levels, with the HSS from CH96/- likely to arrive at Earth towards the end of Day 1 (26 Apr). Forecast wind speeds are 550-600 km/s, with an upper estimate of 650-700km/s possible by Day 2 (27 Apr). The potential arrival of the CME from 24

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April could combine with the HSS to increase the geomagnetic response. The HSS is expected to continue at Earth into Days 3 and 4 (28 and 29 Apr), perhaps with some weakening of the winds during Day 4.
Geomagnetic activity is expected to be at Quiet to Unsettled levels through much of Day 1, increasing to Unsettled or Active with a slight chance of G1/Minor Storms (Kp5) as the HSS arrives, then a possible further increase with the first CME giving a slight chance of a G2/Moderate Storm (Kp 6). Activity is then likely to wane through Days 3 and 4, although the risk of a further CME glancing blow on Day 3 could prolong a slight chance of G1 intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to continue at background levels. High energy (greater than 2MeV) electron flux is currently at moderate levels, with a rise possible on Day 1 (26 Apr), before a probable decline through Days 2 and 3 (27-28 Apr), followed by a possible increase again on Day 4 (29 Apr). Electron fluence is likely to show a rising trend on Day 1, with a chance of reaching Active (1e8 integrated pfu), followed by a decline through Days 2 and 3. An increase may occur on Day 4 following the expected easing of Geomagnetic activity, but with low confidence.

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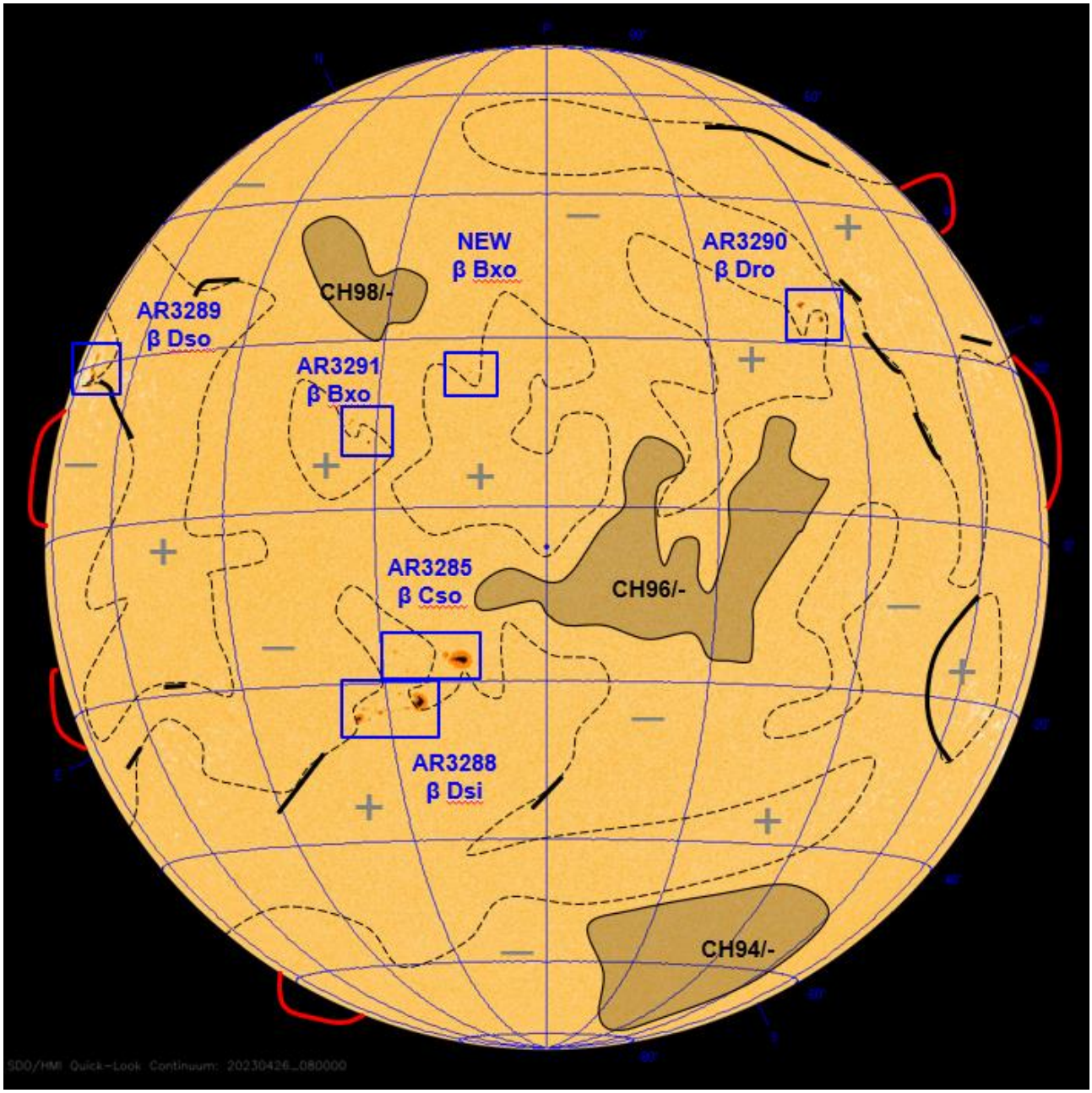
Figure 1. Solar Analysis Valid 26/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption occurred near south centre disc starting around 24/1300 UTC. The CME was observed in coronagraph imagery heading generally south, but some Earth directed component is probable, with this most likely reaching Earth in the first half of Day 2 (27 Apr). Arrival time estimates through ensemble forecasting vary between the very end of Day 1 (26 Apr) and late on Day 2 indicating there is some uncertainty over the timing of this feature passing by Earth. A further filament eruption from the southwest quadrant beginning around 25/1900 UTC gave another CME. This one appears mostly directed ahead of and below Earth's orbit, and is considered most likely to miss, but there is a very low risk of a glancing blow during 28 April.

Solar wind speeds remain at elevated levels, perhaps due to HSS influence from CH95/- which is no longer visible, and the arrival of which would have been masked by the CME which arrived on the 23 April. The HSS from the equatorial CH96/- is likely to arrive at Earth towards the end of Day 1 (26 Apr), similar to persistence. The leading edge of this feature is in a similar location to the last rotation, however, it is a larger and better defined feature than last time. Forecast wind speeds of around 550-600 km/s are reasonable and consistent with the previous rotation, with an upper estimate of 650-700km/s possible by Day 2 (27 Apr). The potential arrival of the CME from 24 April could combine with the HSS to increase the geomagnetic response. The HSS from CH96/- is expected to continue at Earth into Days 3 and 4 (28 and 29 Apr), perhaps with some weakening of the winds during Day 4.

Geomagnetic activity is expected to be at Quiet to Unsettled levels through much of Day 1. The HSS from CH96/- is likely to increase activity to Unsettled or Active with a slight chance of G1/Minor Storms (Kp5). The possible CME arrival on Day 2 could further increase geomagnetic activity, with a chance of G1/Minor Storm conditions and a slight chance of a G2/Moderate Storm (Kp 6). Activity is then likely to wane through Days 3 and 4, although the risk of a further CME glancing blow on Day 3 could prolong a slight chance of G1 intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	50	20	5
Strong	G3	No	1	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/1900	Partial	Filament eruption	SW	700 km/s	27/0300 UTC	Glancing blow likely

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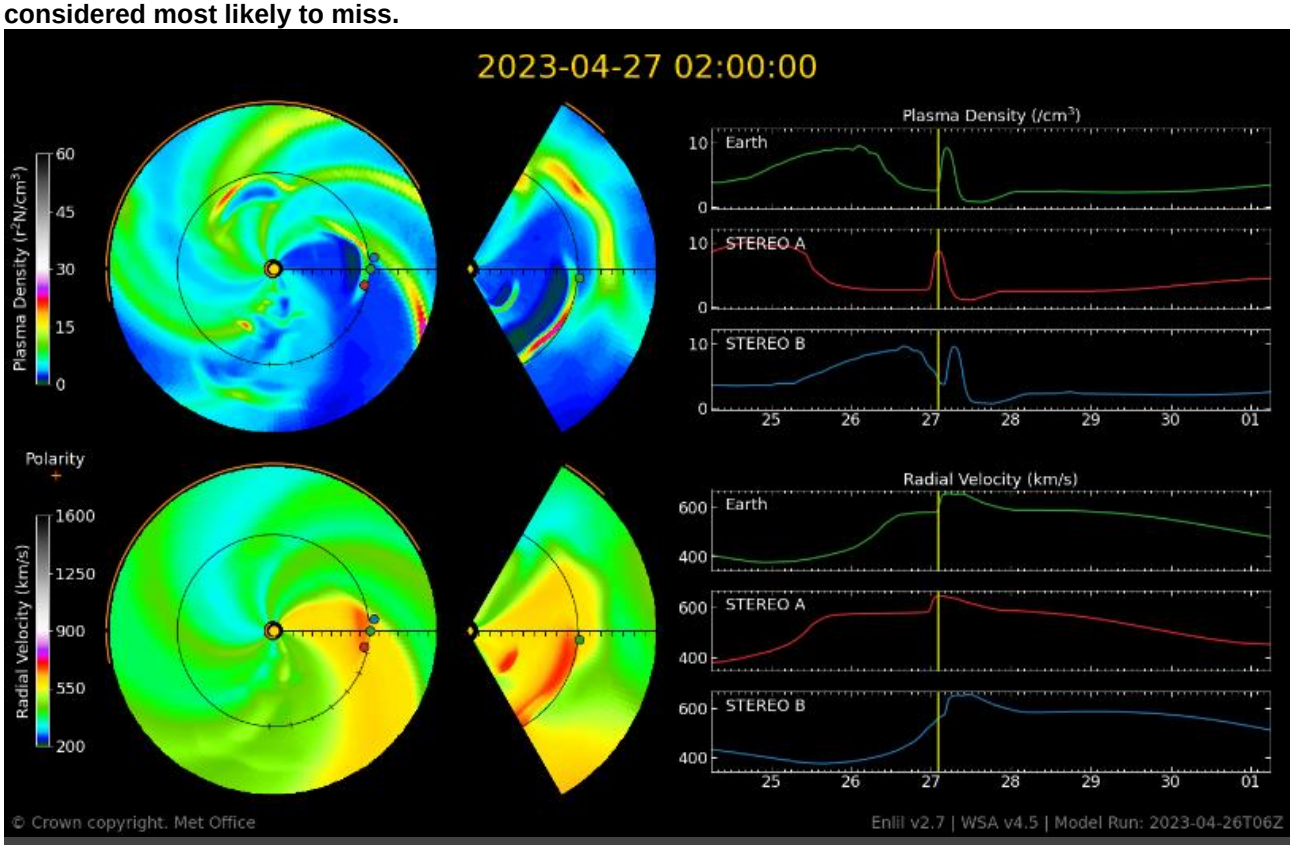
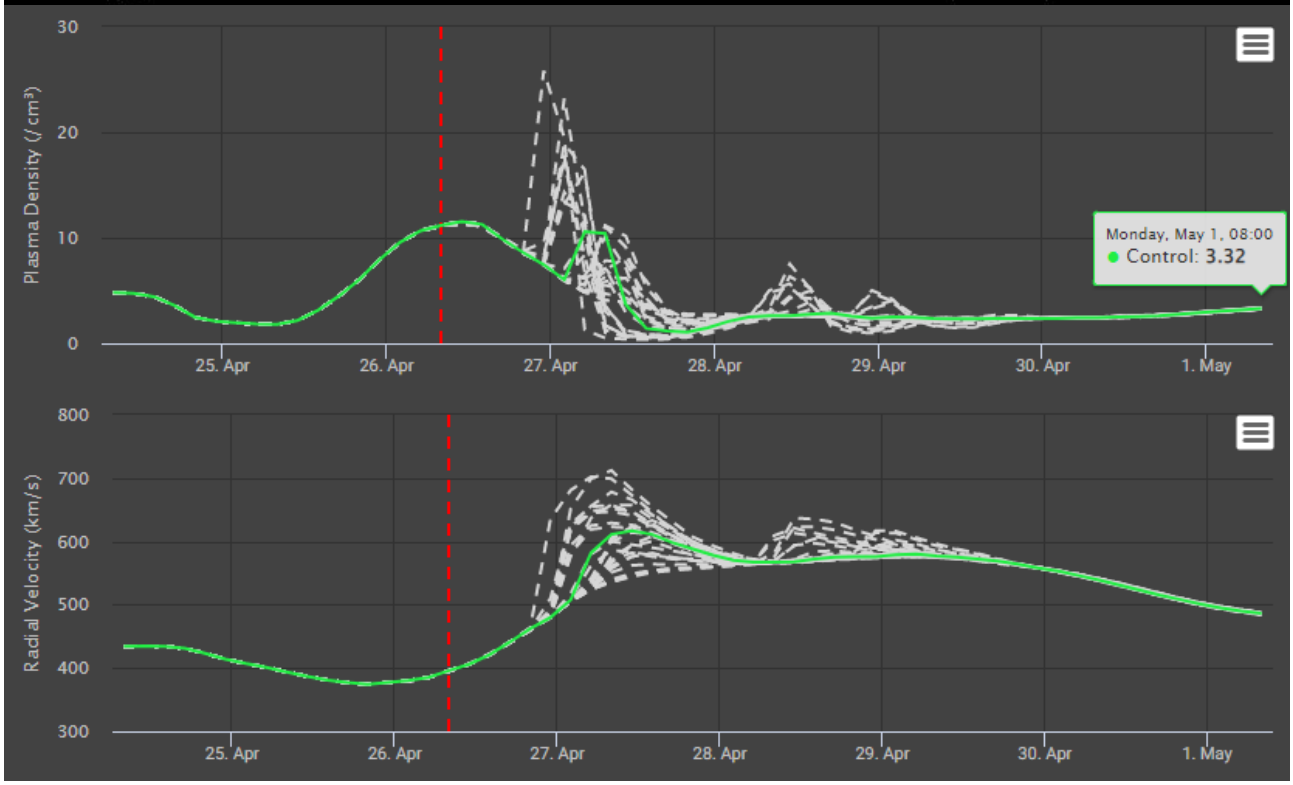
Figure 2: MOSWOC Enlil and ensemble, showing a likely glancing CME blow early on 27 April but with some uncertainty in timing. A further much lower risk of a glancing blow on 28 April, but this is considered most likely to miss.





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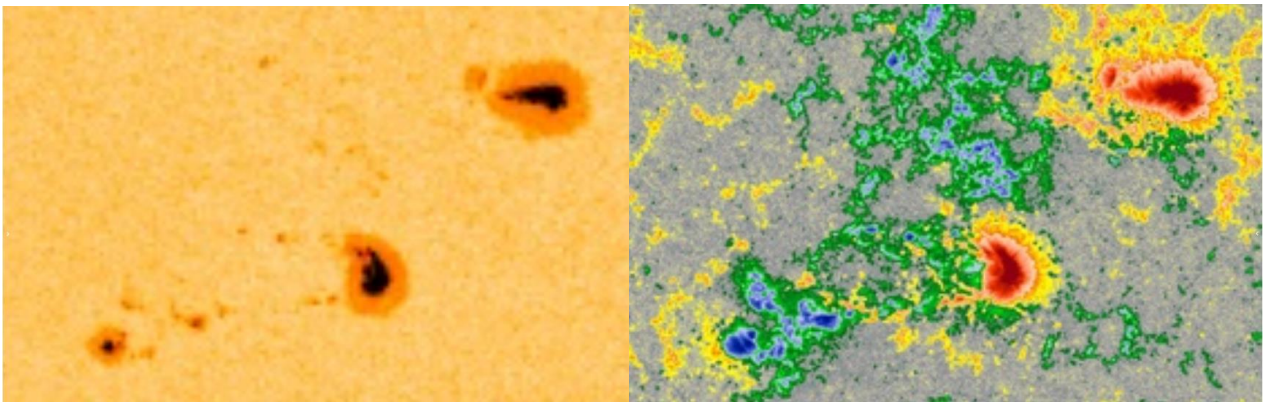
Radio Blackouts - X-Ray Flares:
There are currently six sunspot regions on the visible disc. AR3285 (Cso/Beta) and AR3288 (Dsi/Beta) in the southeast quadrant are currently the two largest regions on the disc, although both are relatively simple, if close together. AR3289 (currently Dso/Beta) near the northeastern limb may prove to be a larger region, but is too near the limb for a complete view or a proper classification. The classification may change as it moves into a clearer viewing position. AR3290 (Dro/Beta) has emerged recently and may continue to develop further in the coming hours. All other remaining sunspot regions are small and simple at present.

Far side imagery indicates some active regions could rotate across the eastern limb during the period, with a possible increase in flare risk. However, until these regions emerge, any increase in flare risk cannot be accurately assessed. Overall solar activity is likely to remain Low, with a slight chance of becoming Moderate with any isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: AR3285 (top) and AR3288 (bottom) are both relatively simple at the present time.



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV) is currently at background levels. There is just a very slightly increasing risk of reaching the S1/Minor Storm level or greater during the period as the various regions rotate westwards.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	3	3
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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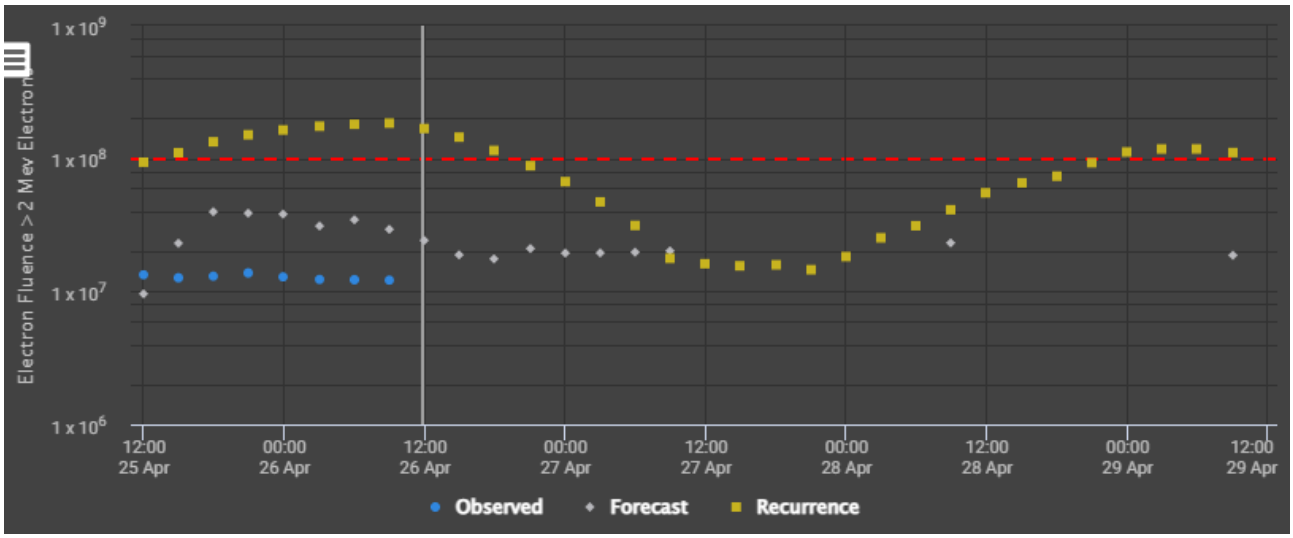
High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2MeV) electron flux remains at predominantly moderate levels. The BAS radiation belt model suggests that electron density has increased in the radiation belt from the recent CME effects. However, continuing elevated wind speeds with an increase likely later today as the HSS from CH96 arrives, mean that the radiation belt may remain compressed with electron flux levels remaining more suppressed at GEO. Flux levels may remain suppressed through Days 2 and 3 (27-28 Apr) with the possibility of further minor geomagnetic activity from combined CME and HSS effects. As HSS effects start to ease through Day 4 (29 Apr), a rise is then possible.

The associated 24-hour integrated fluence is expected to show a slightly rising trend on Day 1, with a chance of reaching Active (1e8 integrated pfu), followed by a decline through Days 2 and 3 (27-28 Apr). An increase may occur on Day 4 following the expected easing of geomagnetic activity, but with low confidence. MOSWOC REFM is forecasting below Active through the next three days, which is reasonable.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	20	5	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM is forecasting a steady trend through the next few days.



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